Department of
Environment &
Conservation

Permanent Stormwater Management For New and Re-Development Sites within MS4 jurisdictions

Environmental Show
Gatlinburg, TN
April 21, 2016

Session outline

- MS4 permit
- Potential Water Quality Impacts of stormwater
- Stormwater treatment options
- Implications for site design and plans review
- Features of the new draft permit

I. MS4 Permitting

- Larger cities are permitted individually as “Phase 1” MS4 programs
  - Knoxville
  - Chattanooga
  - Nashville
  - Memphis
- Smaller cities and counties that meet criteria are permitted as “Phase 2”
- TDOT

TN

40 CFR §122.34 As an operator of a regulated small MS4, what will my NPDES MS4 storm water permit require?

Your NPDES MS4 permit will require at a minimum that you develop, implement, and enforce a storm water management program designed to reduce the discharge of pollutants from your MS4 to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act. Your storm water management program must include the **minimum control measures**

Phase II MS4s must have six program areas ("minimum measures")

1. Public Education and Outreach
2. Public Participation/Involvement
3. Illicit Discharge Detection/Elimination
4. Construction Site Runoff Control
5. Permanent Stormwater Management
6. Pollution Prevention/Housekeeping

- NPDES Permits issued for 5 year period
- Phase 2 general permit first issued in 2003
- Reissued in 2010

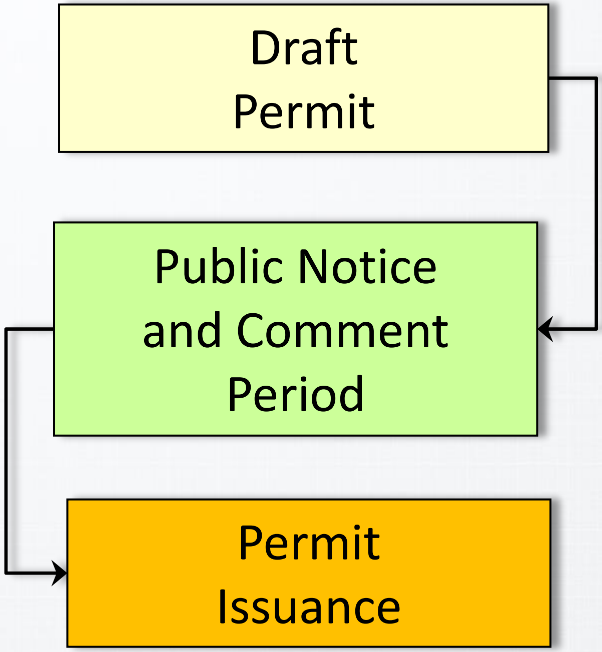
TDEC Permanent Stormwater Manual Dec 2014-
guidance for design and plans review
training pilot program 2014, statewide training 2015

- Stakeholder engagement:
  - TNSA, MS4 programs
  - Home Builders, General Contractors, Land Developers
  - Engineers, Landscape Architects

Permit expired in Sept. 2015, continues in effect until reissued

Draft permit on public notice

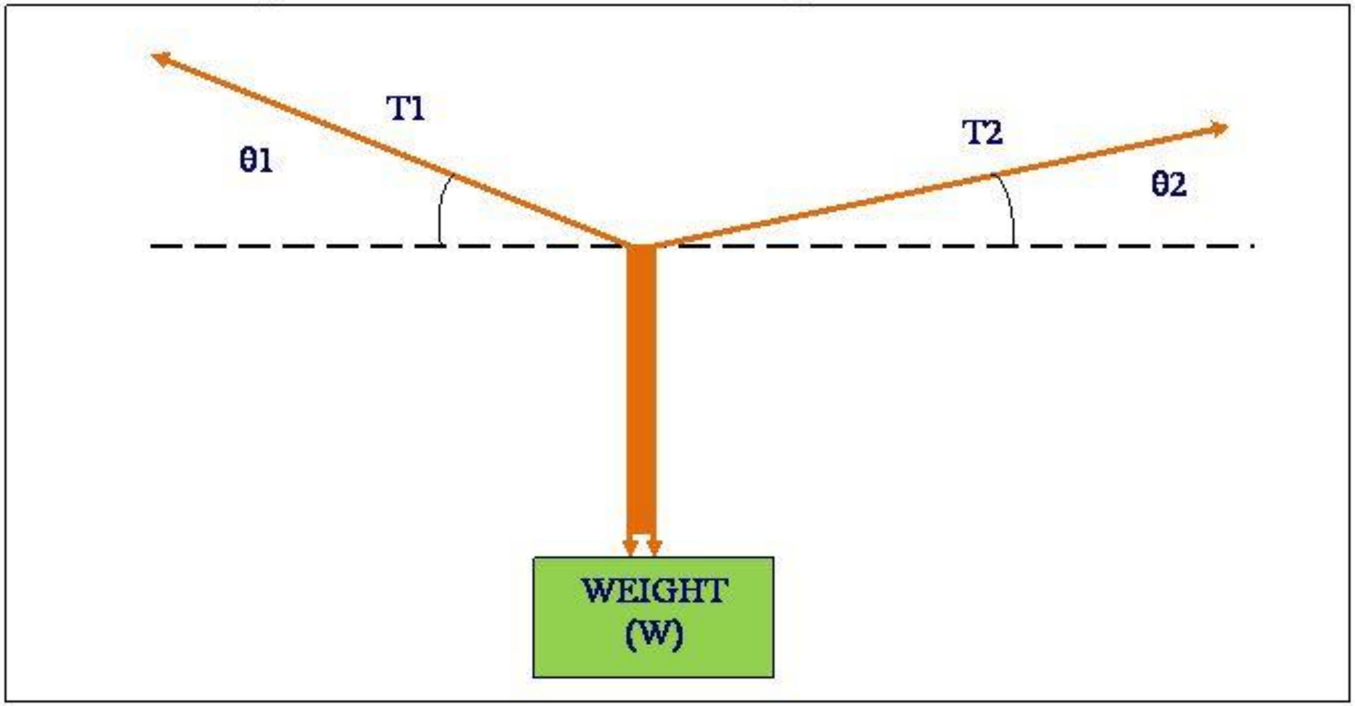
General MS4 Permit Reissuance:



- Draft on public notice February 25th, 2016
- Statewide public hearing April 27th
- Comments received until May 11th
- EPA “90 day” review period (late May)

Timely
Protective

Appropriate
Achievable



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Storm Drains lead to…

Streams and Rivers

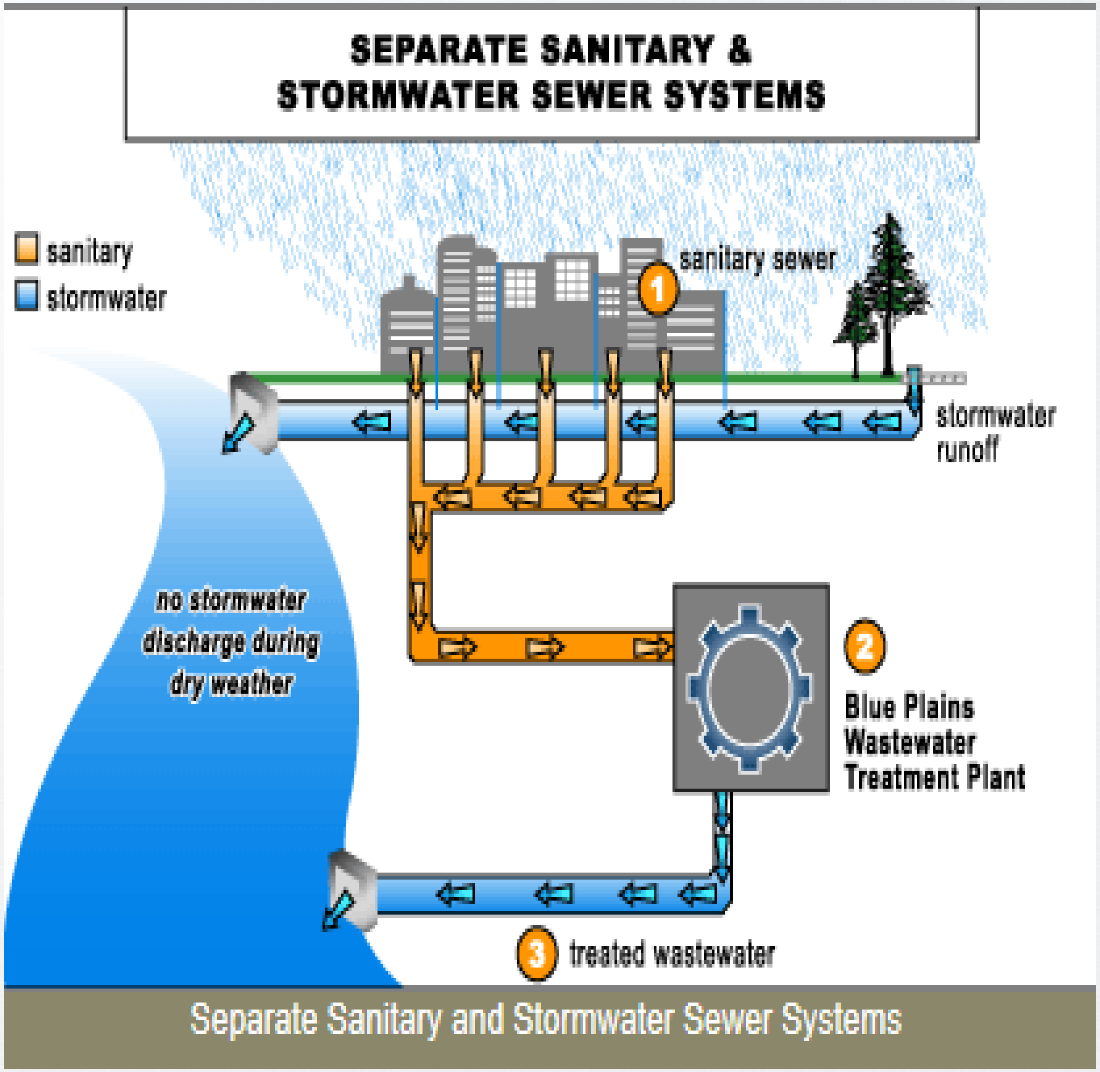
Sanitary sewers lead to

Sewage treatment plants

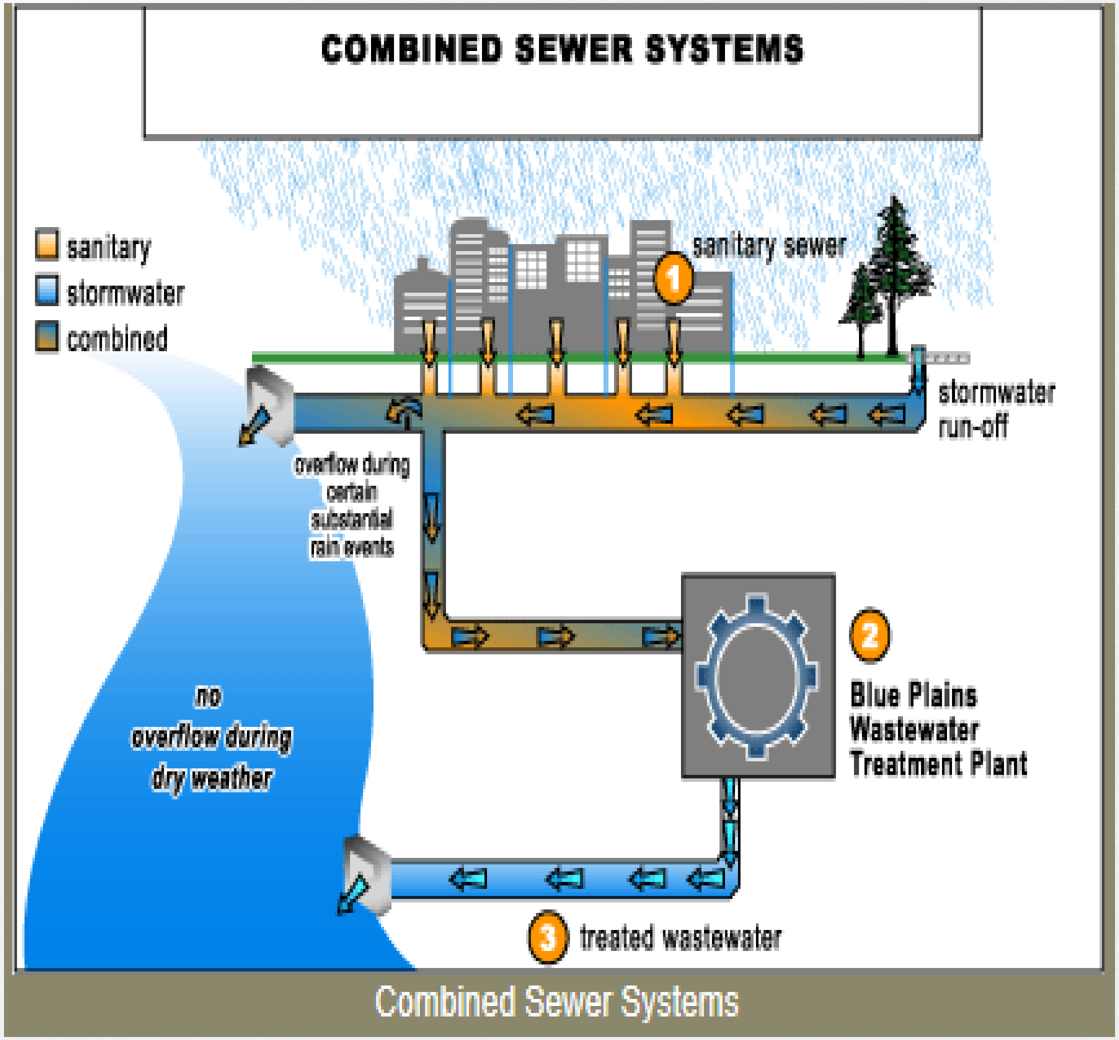
THE UNIVERSITY of TENNESSEE UT
KNOXVILLE
Big Orange. Big Ideas.

TDEC
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION

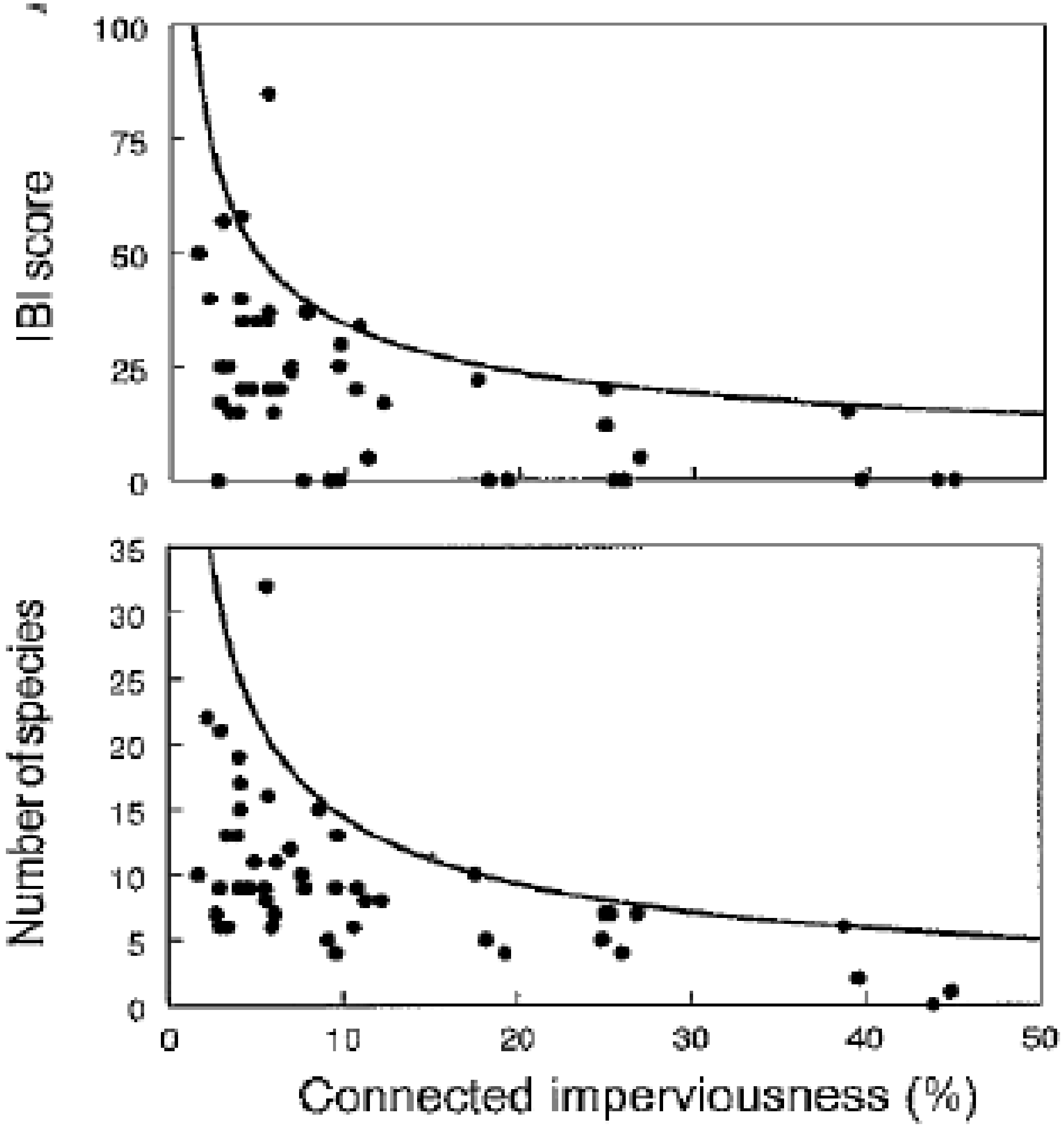
MS 4 = Municipal Separate Storm Sewer System



Though sometimes they are combined…



Source: Dr. Andrea Ludwig, UT Biosystems Engineering



Urban Stormwater Management in the United States

Committee on Reducing Stormwater Discharge Contributions to Water Pollution

Water Science and Technology Board

Division on Earth and Life Studies

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

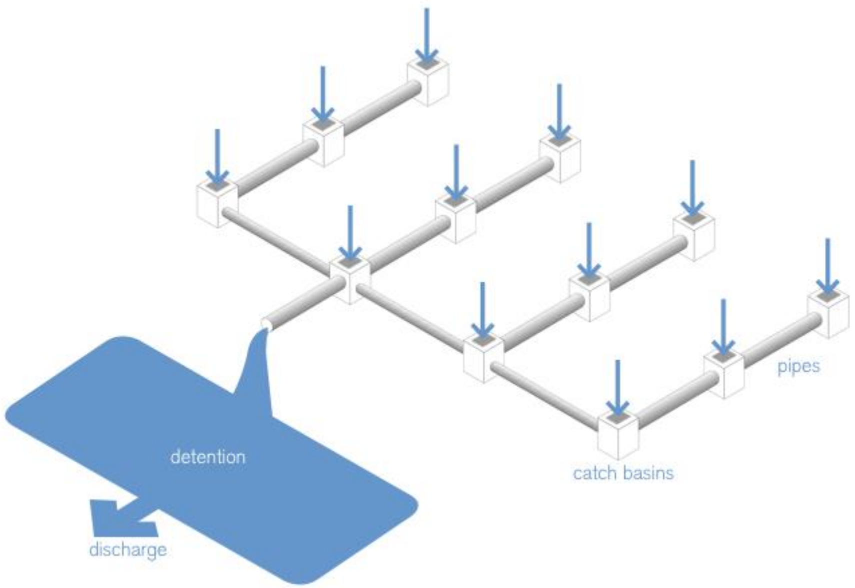
THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

(Source: www.nap.edu)

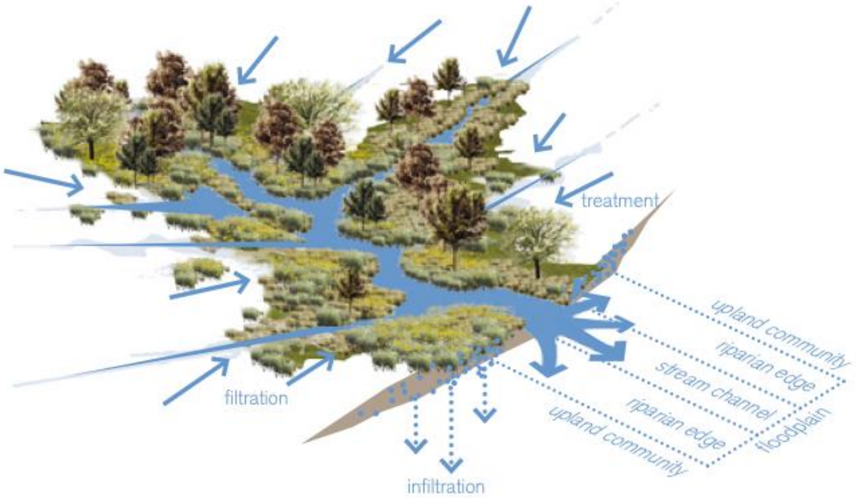
TN

Typical stormwater management

Natural watershed processes



conventional management: "pipe-and-pond" infrastructure
drain, direct, dispatch



low impact management: watershed approach
slow, spread, soak

(Source: University of Arkansas)

Source: Dr. Andrea Ludwig,
UT Biosystems Engineering

International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary Statistical Addendum:

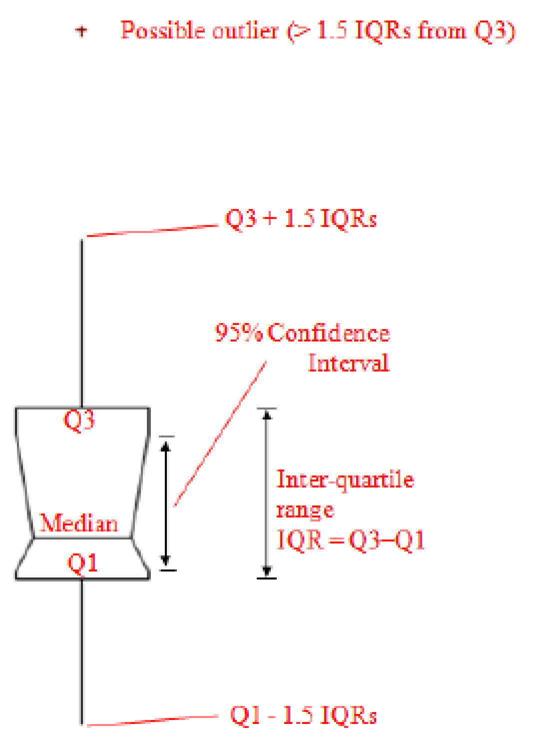
TSS, Bacteria, Nutrients, and Metals

Prepared by
Geosyntec Consultants, Inc.
Wright Water Engineers, Inc.

Under Support From
Water Environment Research Foundation
Federal Highway Administration
Environment and Water Resources Institute of the
American Society of Civil Engineers

July 2012

Figure 1. Box Plot Key



Source: www.BMPdatabase.org

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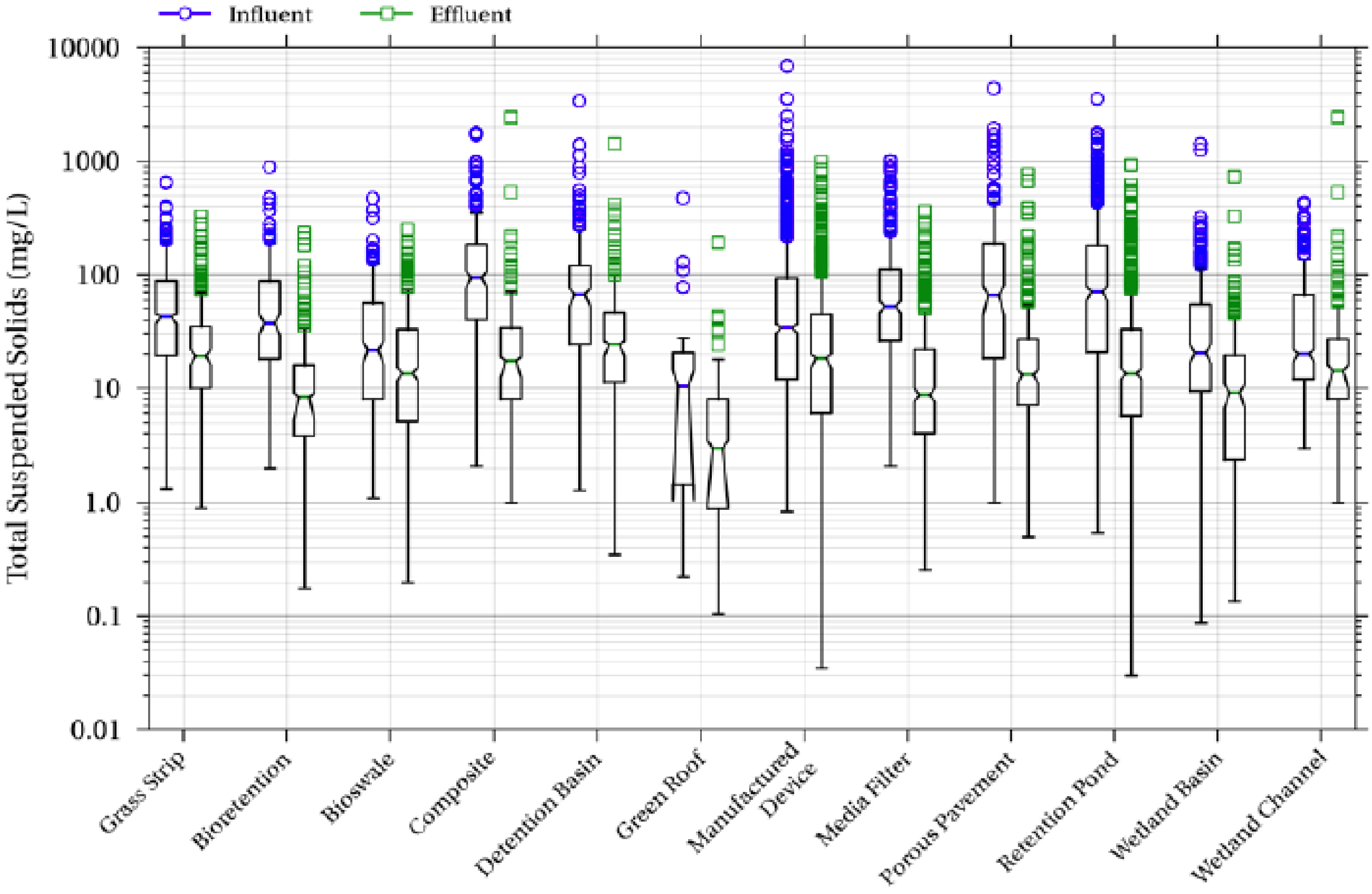
Figure 2. Box Plots of Influent/Effluent TSS Concentrations



Pathogens

Figure 4. Box Plots of Influent/Effluent *E. coli* Concentrations

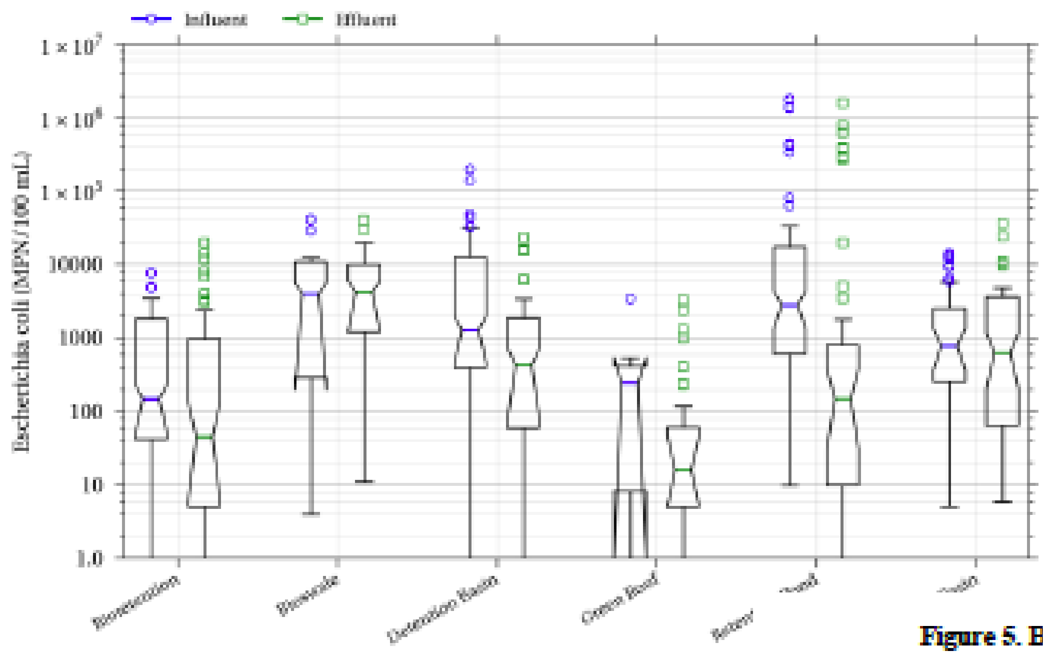
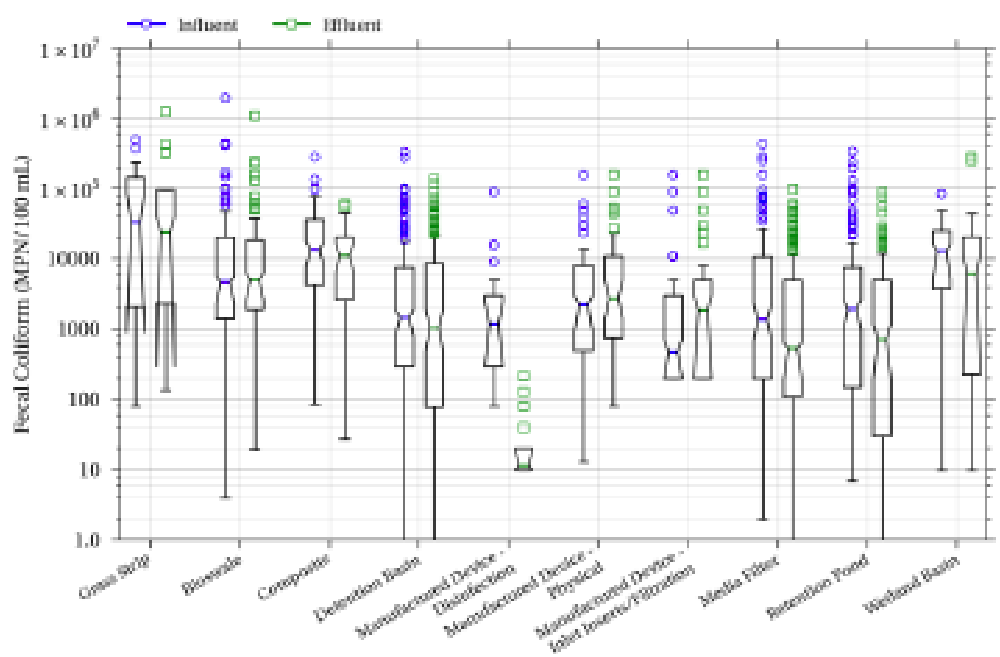


Figure 5. Box Plots of Influent/Effluent Fecal Coliform Concentrations



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Metals

Figure 7. Box Plots of Influent/Effluent Total Arsenic Concentrations

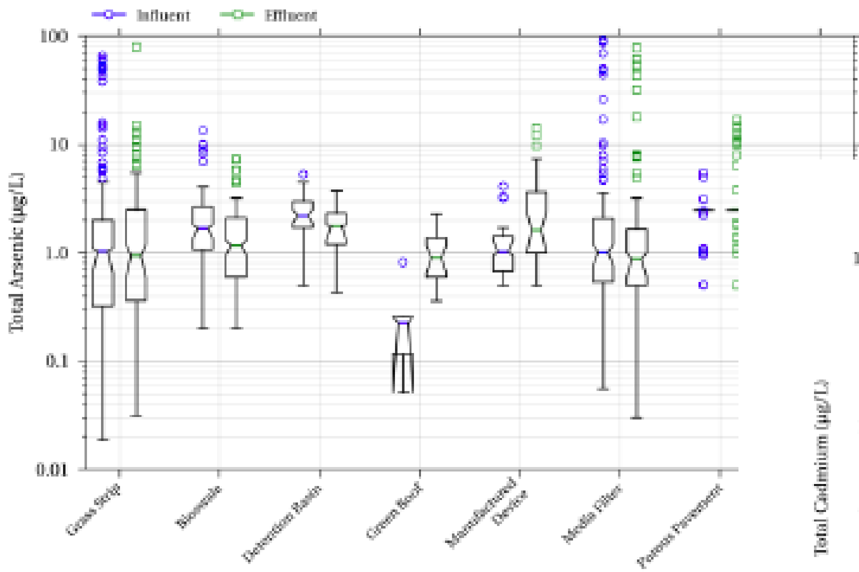


Figure 9. Box Plots of Influent/Effluent Total Cadmium Concentrations

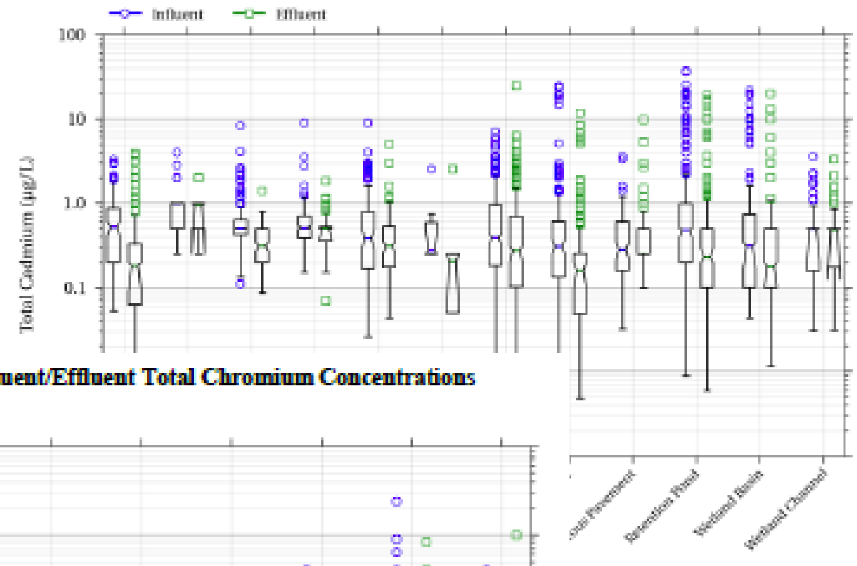
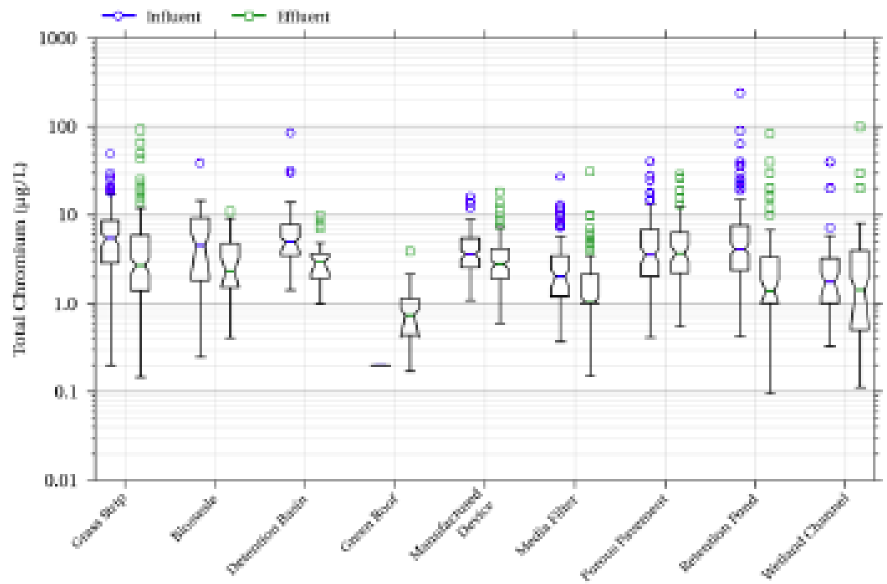


Figure 11. Box Plots of Influent/Effluent Total Chromium Concentrations



Nutrients (Phosphorus and Nitrogen)

Figure 22. Box Plots of Influent/Effluent Total Phosphorus Concentrations

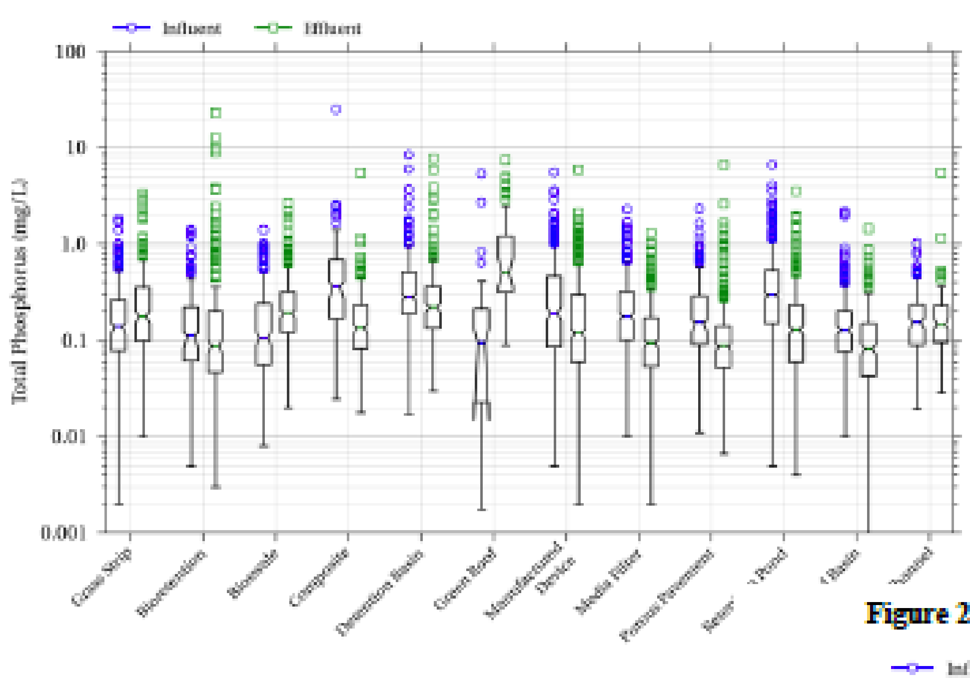
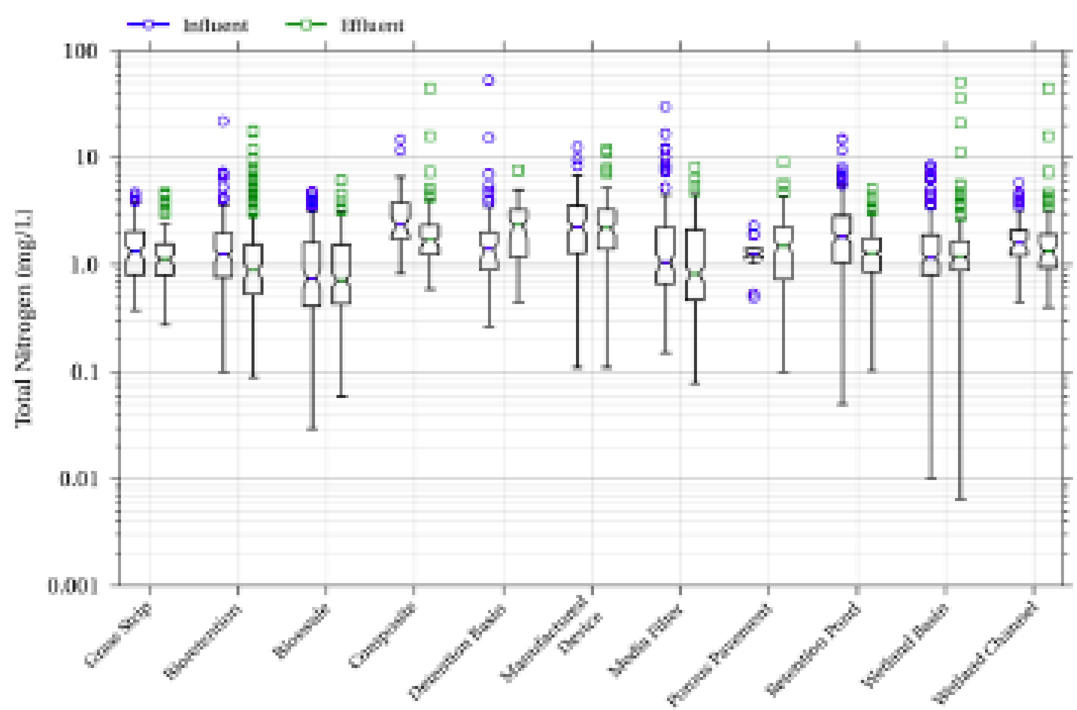


Figure 25. Box Plots of Influent/Effluent Total Nitrogen Concentrations



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Potential pollutants:

- TSS
- Pathogens
- Nutrients
- Heavy metals
- Oil and Grease

Measuring all of these is expensive

Use TSS as an indicator of other pollutants

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- **60,000 miles** of streams and rivers in Tennessee

- **570,000 acres** of reservoirs and lakes

Recreational activities are one of the most important resources water provides. Photo provided by Jimmy Smith (Natural Resource Section).

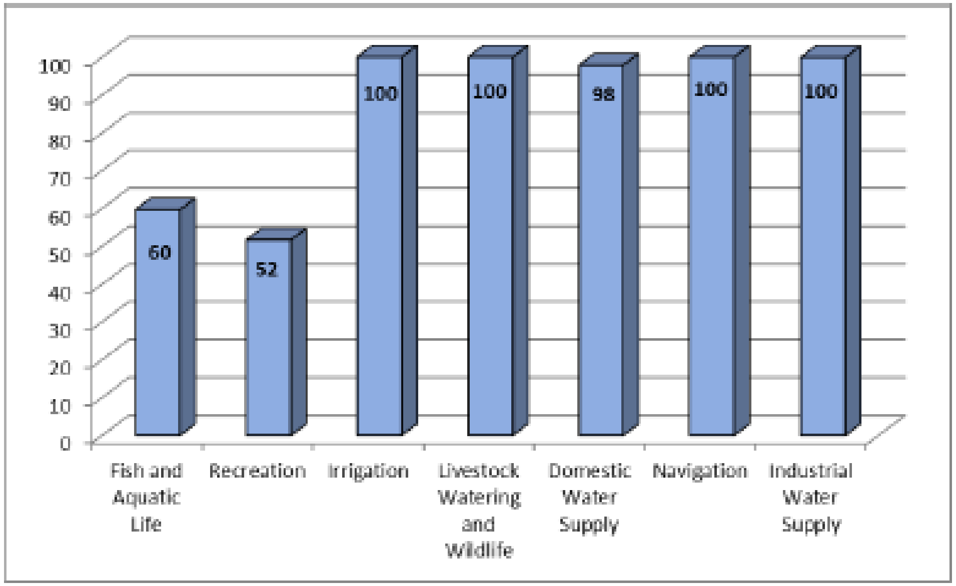


Figure 7: Percent Use Support for Individual Classified Uses in Assessed Rivers and Streams

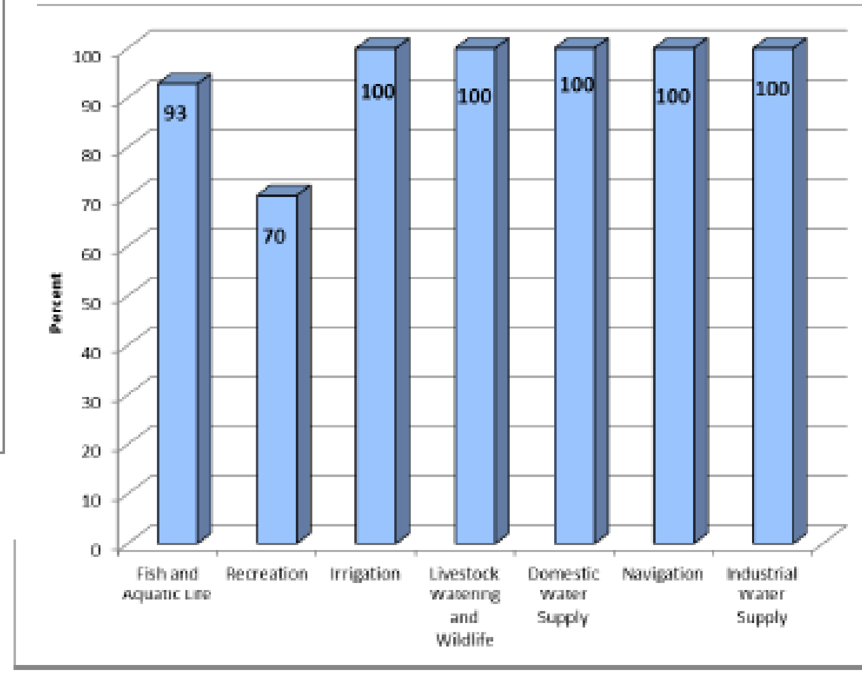


Figure 9: Percent Use Support for Individual Uses in Assessed Reservoirs and Lakes

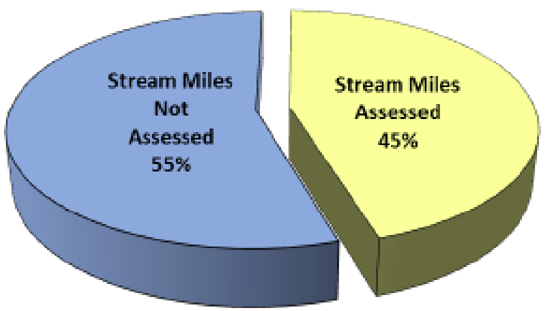
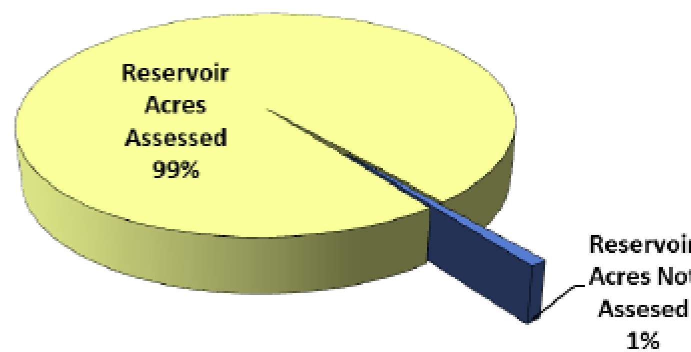


Figure 4: Percent of River and Stream Miles Assessed



Source: *Tennessee 305b Report (2014)*

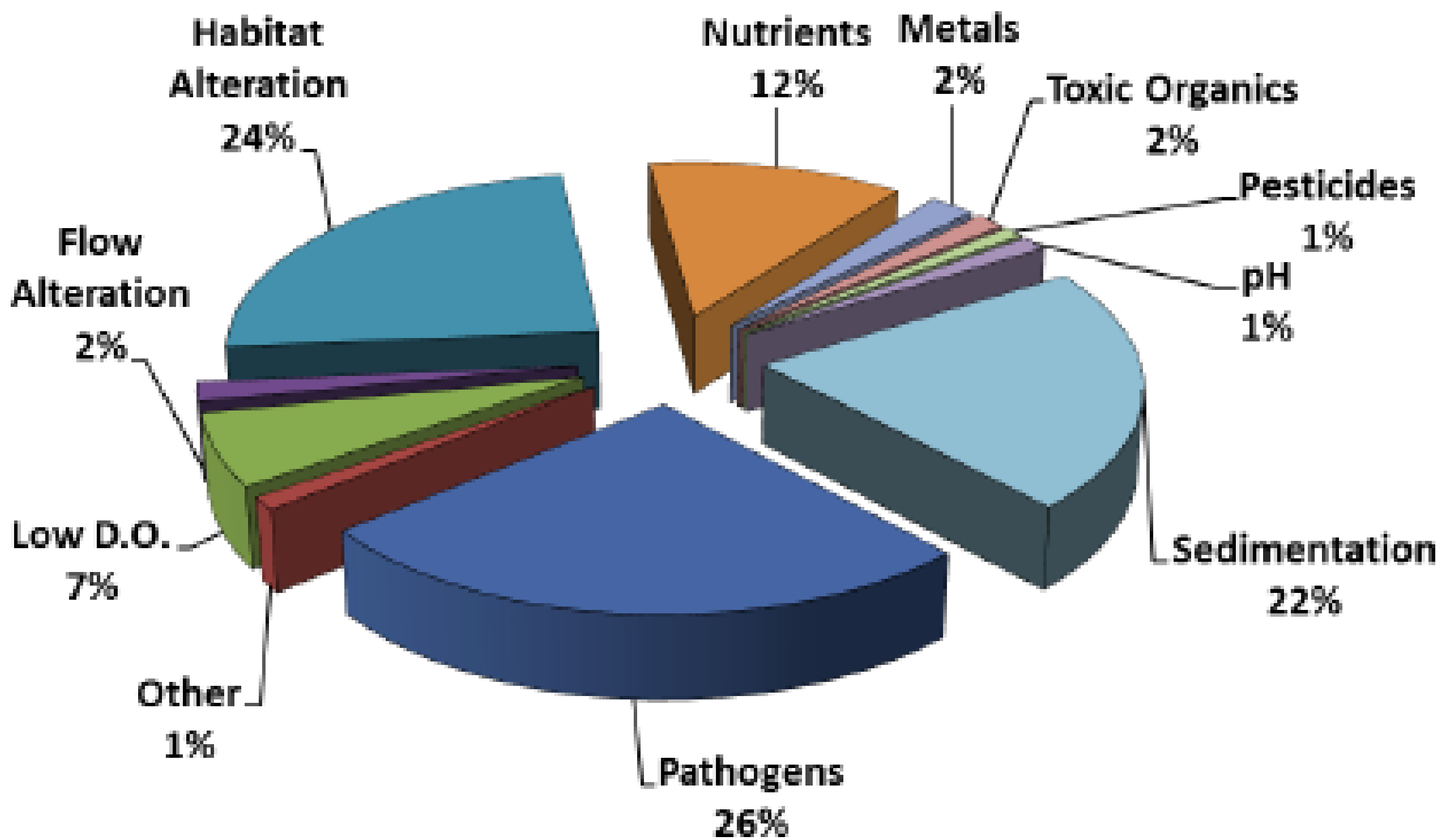


Figure 10: Relative Impacts of Pollution in Impaired Rivers and Streams

Source: *Tennessee 305b Report (2014)*

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TN

Existing 2010 permit requirements

Site design standards for all new and redevelopment require, in combination or alone, management measures that are designed, built and maintained to infiltrate, evapotranspire, harvest and/or use, at a minimum, the first inch of every rainfall event.

For projects that cannot meet 100% of the runoff reduction requirement unless subject to the incentive standards, the remainder of the stipulated amount of rainfall must be treated prior to discharge with a technology reasonably expected to remove 80% total suspended solids (TSS).

Emphasis in reissued permit will be on pollutant removal from a Water Quality Treatment Volume (WQTV)

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2016 draft permit requirements

The permanent stormwater management program must require New Development Projects to be designed to remove pollutants to the MEP.

SCMs that rely on infiltration, evapotranspiration, or capture/reuse of the water quality treatment volume (WQTV), as defined in sub-section 4.2.5.2.2, are practices that approach 100% pollutant removal and constitute MEP where site-specific conditions allow.

If site-specific limitations as described in sub-section 4.2.5.2.1 do not allow infiltration, evapotranspiration, or capture/reuse of the entire WQTV, alternative SCMs may be authorized to treat the remaining portion of the WQTV. Such alternative SCMs must maximize pollutant removal consistent with site-specific limitations and, at a minimum, be designed to achieve 80% TSS removal.

The WQTV is defined as the runoff generated from impervious surfaces during the first inch of a rainfall event. A representative storm event or a volumetric runoff coefficient (Rv) can be used to review plans for the WQTV.

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- Local MS4 program sets approval criteria
- Based on site design
- Evapotranspiration is the most effective treatment (Can achieve 100% pollutant removal)

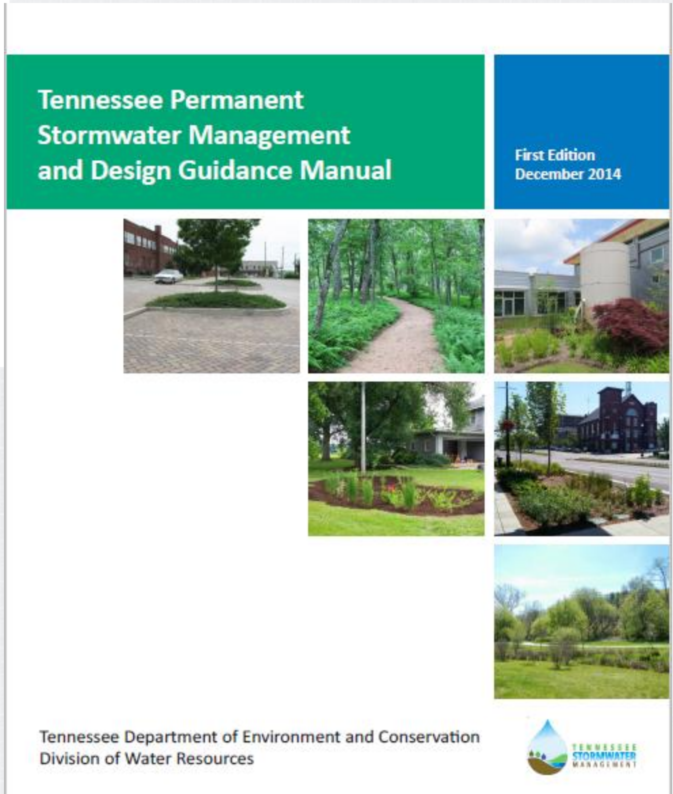
TN

Table 4.2: Summary of literature findings on TSS removal by SCMs.

Stormwater Control Measure	Pollutant Removal Efficiency (%)			
	By Storage Infiltration	Drain Discharge	Surface Removal (Flowthrough)	Literature (Average)
Dry Detention	100	NA	40	40
Extended Detention	100	NA	60	80
Wet Ponds	100	NA	80	70
Vegetated Swales	100	NA	25	65 / 85
Managed Vegetated Areas	100	NA	NA	NA
Filter Strips	100	NA	30-35	70
Bioretention	100	85	10	85
Infiltration Areas	100	NA	25	65
Permeable Pavement	100	65	NA	80
Green Roofs	100	NA	NA	NA
Rainwater Harvesting	NA	100	100	NA
Stormwater Treatment Wetlands	80	NA	50-80	80
Manufactured Treatment Devices	NA	NA	50-80	50-100
Underground Infiltration Systems	100	40	NA	50

NA – Not Applicable. References: Chesapeake Bay Program (2006), Center for Watershed Protection (2007), New Hampshire Department of Environmental Services (2008)

http://TNpermanentstormwater.org



5.4.3 Vegetated Swale (Water Quality Swale)

Description: Designed to manage runoff primarily by reducing its velocity for increased treatment efficiency by a downstream practice, vegetated surfaces provide water quality pretreatment through filtering, biological uptake mechanisms, and subsoil cation exchange capacity. Subsoil can also provide a relatively small amount of runoff volume reduction especially when check dams are used. These attributes, in addition to low installation and maintenance costs, make the vegetated swale preferable to the traditional system of curb and gutter, storm drains, and pipes for managing stormwater runoff.

Figure 1: Roadside channel in Spokane, WA.

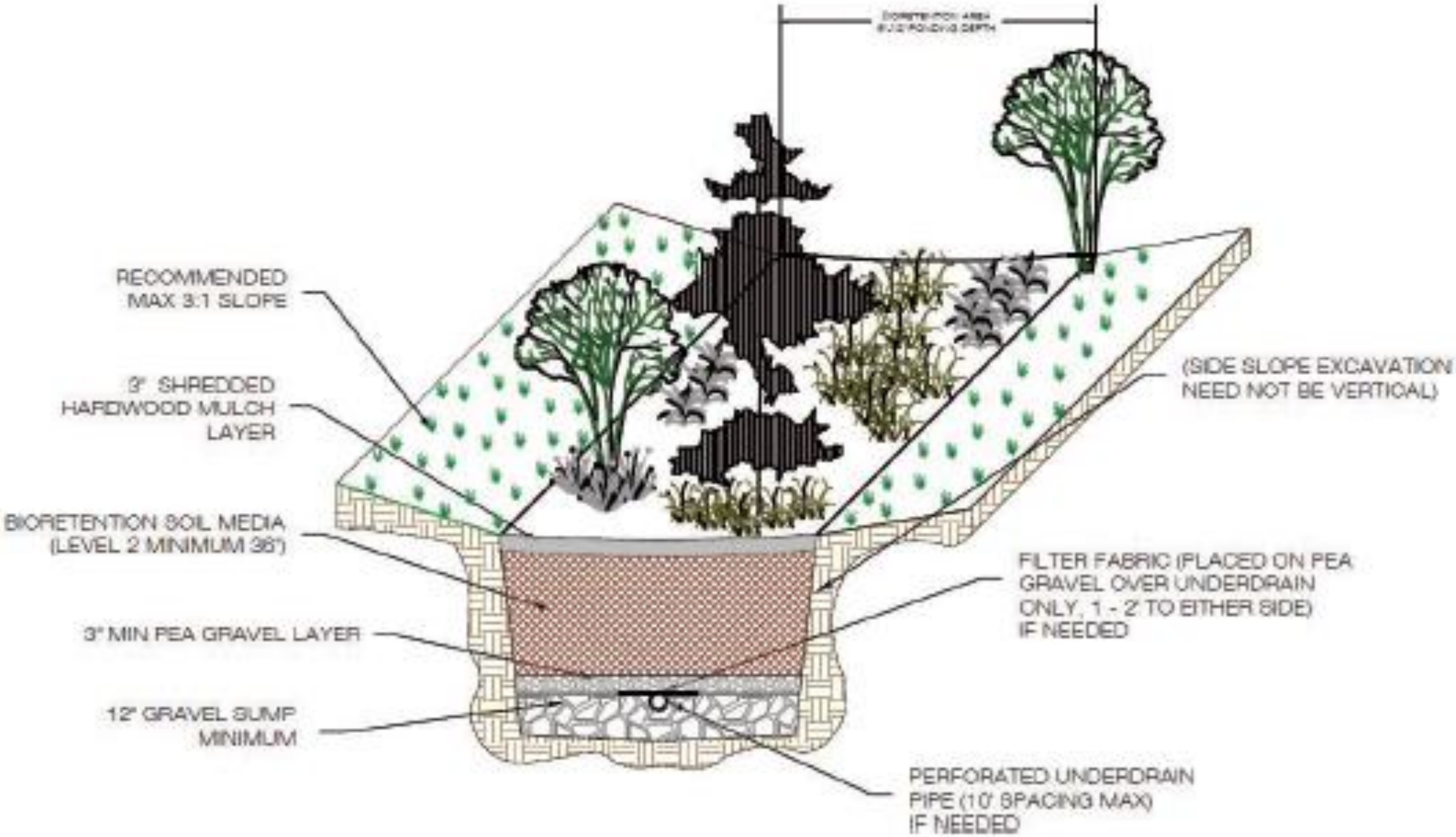
5.4.5 Filter Strips

Description: Filter strips are areas of dense vegetation located between runoff pollutant sources and other SCMs or receiving water bodies. Filter strips may be constructed of turf, meadow grasses, or other vegetation such as landscape plantings. Filter strips act to impede the velocity of stormwater runoff (thereby allowing sediment to settle out), to reduce the impacts of temperature, and to encourage infiltration. Filter strips are a water quality SCM to slow the rate of runoff, reduce peak flows, and to allow for infiltration to a lesser extent.

Figure 1: Filter strip along highway (Source: Virginia).

TN

Figure 18: Typical section with underdrain (Source: VADCR).



5.4.6a Urban Bioretention

Variations: Planter box, Extended tree pits, Stormwater curb extensions.

Description: Urban bioretention SCM are similar in function to regular bioretention practices except they are adapted to fit into "containers" within urban landscapes. Typically, urban bioretention is installed within an urban streetscape or city street right-of-way, urban landscaping beds, tree pits and plazas, or other features within an Urban Development Area. Urban bioretention is not intended for large commercial areas. Rather, urban bioretention is intended to be incorporated into small fragmented drainage areas such as shopping or pedestrian plazas within a larger urban development.

Figure 1: Urban planter box (Source: The SMART Center).

Urban bioretention features hard edges, often with vertical concrete sides, as contrasted with the more gentle earthen slopes of regular bioretention. These practices may be open-bottomed, to allow some infiltration of runoff into the sub-grade, but they generally are served by an underdrain.

TN

5.4.7 Infiltration Areas

Description: Infiltration areas are properly sized engineered vegetated areas designated to receive runoff from disconnected roof downspouts, driveways, parking lots, and other impervious areas. Infiltration areas are low cost and have been proven to reduce the volume and flows associated with stormwater runoff.

Figure 1: Roof downspout is directed to an infiltration area (Source: The SMART Center).

5.4.1 Dry Detention

Description: Temporarily ponding runoff in basins to enable particulate pollutants to settle out and reduce the maximum peak discharge to the downstream channel, thereby reducing the effective shear stress on banks of receiving streams. The primary pollutant removal mechanism is gravitational settling. This measure is mainly used for peak flow attenuation and receives little credit for runoff reduction or pollutant removal, therefore, basins should be a part of a greater system of SCMs.

Figure 1: A dry detention basin with a pilot channel.

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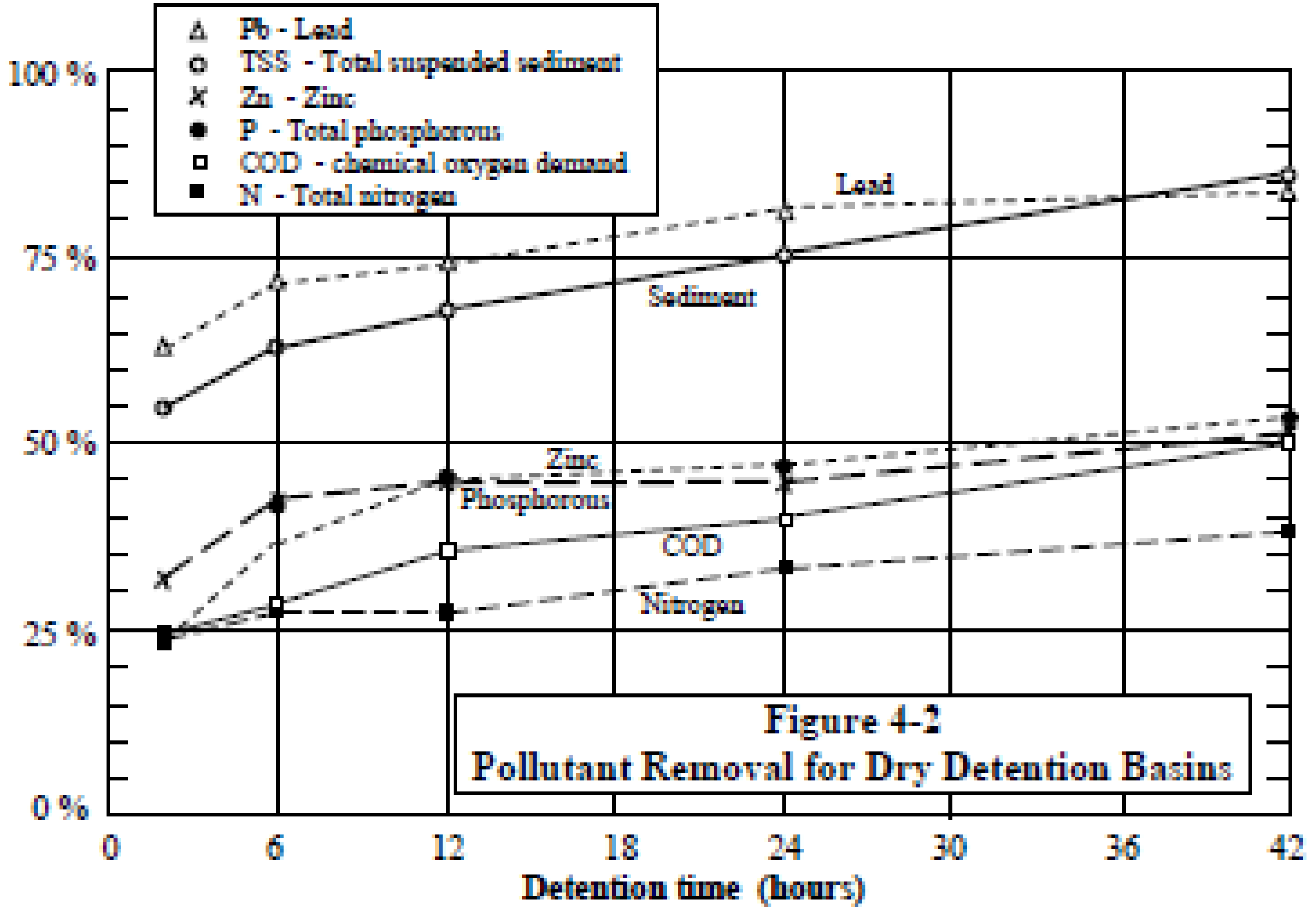

Figure 4-2
Pollutant Removal for Dry Detention Basins

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- How much rain?
- What about soil properties?
- How much benefit from a control?
- How big does it need to be?
- How to calculate treatment?

“representative rainfall event”

or

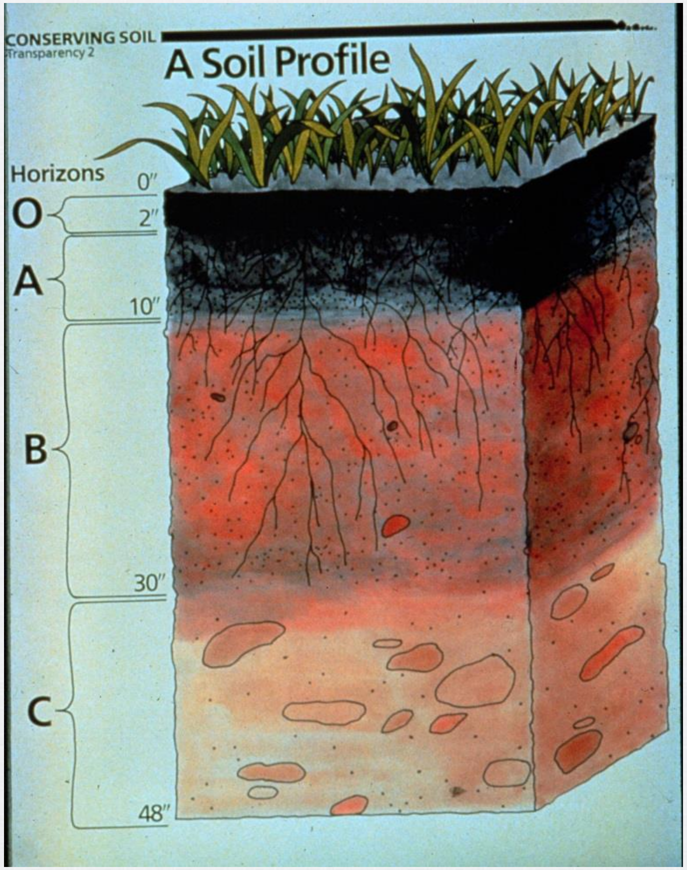
“average annual runoff”

the timing of rainfall is important

“first inch” or “an inch”

Soil Layers and layer thickness are important

- Soil horizons
- Soil texture
- Soil structure
- Moisture holding capacity
- Restrictive layers/ Bedrock
- Vegetation



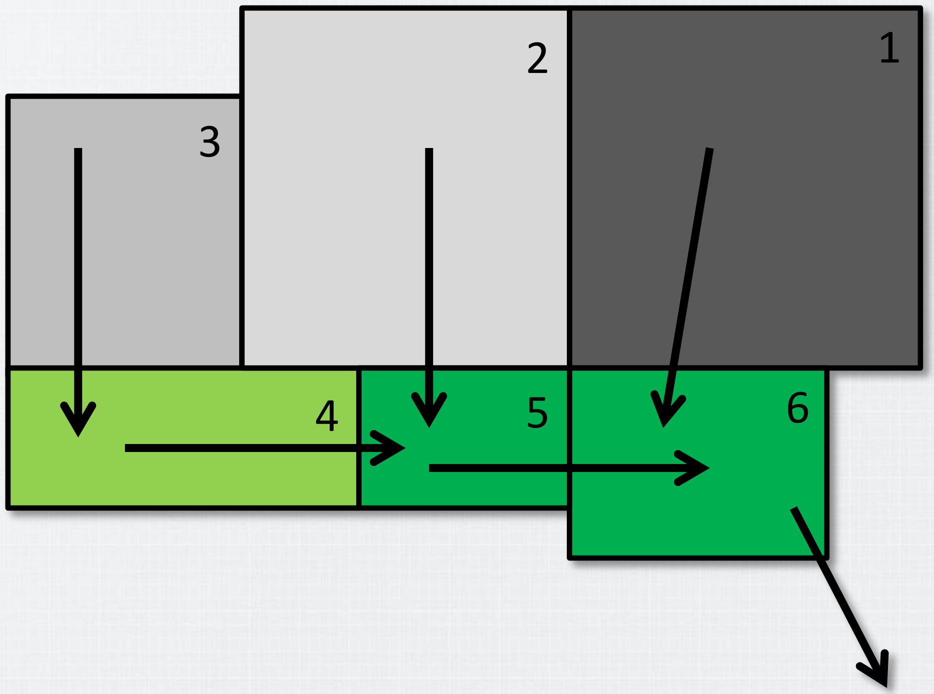
Plants and storage volume

- We depend on plants to pull water out of that volume (between events)
- Pollutants removed from water as it passes into soil during infiltration

Defined landscape **design units**
(impervious, turf, swale, bioretention, dry detention, etc)

Each unit is unique

- Area
- Land use
- Soil type and depth
- Contributing area
- Receiving area



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Rainwater Harvesting	NA	100	100	NA
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Manufactured Treatment Devices	NA	NA	50-80	50-100
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Training Courses For Permanent Stormwater Control Measures

Introduction to the Tennessee Runoff Reduction Assessment Tool
UT SMART Center and TDEC
2015-05-26

1. Purpose

The purpose of this document is to provide a description of the proposed Tennessee Runoff Reduction Assessment Tool (RRAT), which is designed to give practitioners a logical, easily-understood, and easily-used tool for designing stormwater management systems. The document itself is written for designers and engineers with a sufficient understanding of hydrology and stormwater practices to understand the fundamental hydrologic approach. It is not meant as a User Guide for actual use of the tool.

2. Background

2.1. Broad goals based on federal regulations implemented with respect to the TN Water Quality Control Act

In linking stormwater management to the goals of the Clean Water Act, EPA's ultimate stormwater management strategy (EPA, 2005; EPA, 2009; EPA, 2010a) is to minimize three common negative impacts of development on site hydrology: 1) reduced infiltration, which results in less groundwater recharge and baseflow; 2) higher peak runoff rates, causing flooding and increased stream channel erosion; and 3) a first flush of contaminants—usually from impervious surfaces—resulting in poor water quality. EPA's preferred solution to this is a combination of infiltration, detention, and treatment practices that will restore the site hydrology as much as possible to what would occur in the "natural" pre-development condition, defined as the established forest, grassland, or rangeland that would have been on the site before human intervention. Failing that, EPA provides for an alternative approach based on the understanding that in most locations the vast majority of rainfall occurs in relatively small storms, so being able to infiltrate and treat those will go a long ways towards minimizing the runoff and first flush negative impacts. The flooding problem is already largely managed in many jurisdictions through large-storm detention requirements, which leaves a primary need for enhancing onsite stormwater reduction and first-flush treatment.

- Free tutorials and basic version on-line
- design and review course
- inspection and maintenance course

TNstormwatertraining.org

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Draft permit increases flexibility for local programs. Emphasis is on local control:

- T/E species
- Annual Report public process
- Monitoring
- Buffers
- Permanent Stormwater
- BMP maintenance
- Implementation deadlines

TN

1. T/E species

removed duplicative requirement to document and report

Annual reports

- Public must be informed; public hearing not specified

Analytical Monitoring. Choose between two options.

Option 1. Continue benthic sampling if desired (SQSH). One sample per impaired segment.

Option 2. Develop jurisdiction-specific plan to address the following, if desired:

- Measure the effectiveness of the permittee's stormwater management program;
- Evaluate stormwater impacts to the receiving waters;
- Identify sources of specific pollutants, including siltation, nutrients and pathogens;
- Gather data to inform program decisions and prioritization of future activities;
- Utilize division protocols identified above in Option 1; and
- Include any monitoring required by a TMDL that is applicable to MS4s

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Permanent Stormwater

Local requirements should mesh with other local codes (landscaping, detention, setbacks)

a. Existing programs in compliance with existing permits are accepted
b. Emphasizes pollutant removal, removes runoff reduction.

Requires treatment of WQTV to MEP, defined as 100% pollutant removal

c. Compliance with these standards is determined by meeting design criteria and not by analytical monitoring of stormwater discharges.
d. TSS may be used as the indicator for the removal of pollutants
e. Requires removal of pollutants to the 'Maximum extent practical'
f. Minimum pollutant removal efficiency at 80%

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Permanent Stormwater

g. MS4 has control over allowable exceptions (site limitations)

h. MS4 has option to allow mitigation projects or to create a mitigation fund (in-lieu fees)

i. WQTV is defined as the runoff generated from impervious surfaces during the first inch of a rainfall event

j. Currently approved methods to review design plans for WQTV are recognized:
- representative rainfall event as in RRAT,
- volumetric runoff methods (Rv)

k. Allows up to 20% reduction in WQTV by any one incentive, 50% max total, for redevelopment, high density, or transit-oriented; and for protecting riparian areas where otherwise not required

Buffers

Creates 'Allowable uses' within the buffer

Creates pollutant removal 'credit' for treatment provided by buffers
(by allowing infiltration-based SCMs in outer zone,
by increasing treatment for discharges to streams with unavailable parameters,
by increasing treatment of WQTV where needed,
or by allowing reduction of the WQTV through incentive)

Allows landscaping and maintenance.

Does not require "undisturbed buffer".

Allows grass zone or infiltration-based SCMs
in outer zone and inner forested zone.

Buffers- summary

Buffers are required in impaired watersheds

Buffers are required if WQTV not treated to 100% TSS removal

Buffers recommended and can be incentivized if not otherwise required

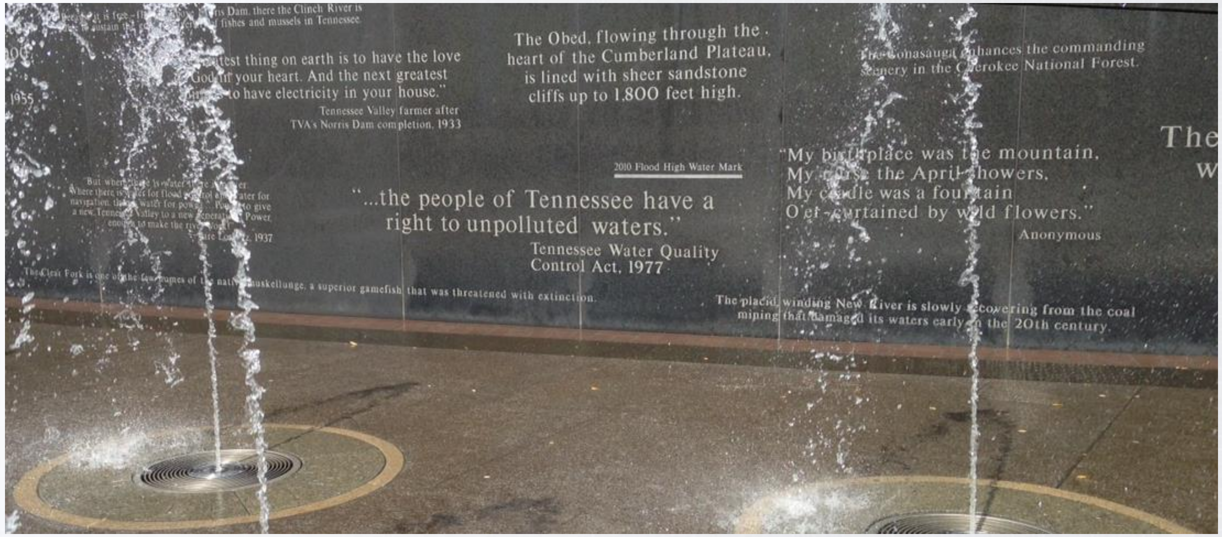
Requirements related to BMP maintenance were simplified. The following were **removed**:

a. Requirement to obtain signed maintenance agreements
b. Mandatory inspection frequencies
c. Minimum qualifications for inspectors (PE, LA)
d. Mandatory inventory and tracking

Implementation deadlines

a. NOI due within 90 days of general permit issuance
b. Permanent stormwater implementation plan due within 180 days of permit issuance, full implementation should be ASAP, but no more than 24 months after NOC (and with milestones required if longer than 12 months)
c. Alternate monitoring plan due within first year, if desired, to be implemented over 5-yr permit term
d. Existing deadlines from 2010 permit were extended in early 2016 to allow time to transition to the new requirements

Allows time for MS4 programs to develop and implement procedures



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THANK YOU